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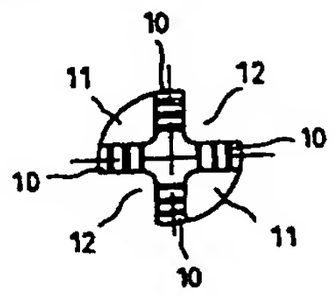
(54) Abstract Title
A filter element for a fuel injection valve for an internal combustion engine

(57) A fuel injection valve for an internal combustion engine has a rod shaped filter body 52 disposed in a fuel duct 51 upstream of an injection nozzle; the filter body 52 comprises at one end a collar 15 and at the other end a collar 16, which fills the fuel duct, and at least one filter element 10 which is connected to the fuel duct by way of orifices in the collars 15, 16; the filter element or elements 10 comprising a plurality of orifices or bores 19, preferably extending in a radial direction, which have an orifice cross section smaller than the orifice cross section of jets orifices in the injection nozzle.



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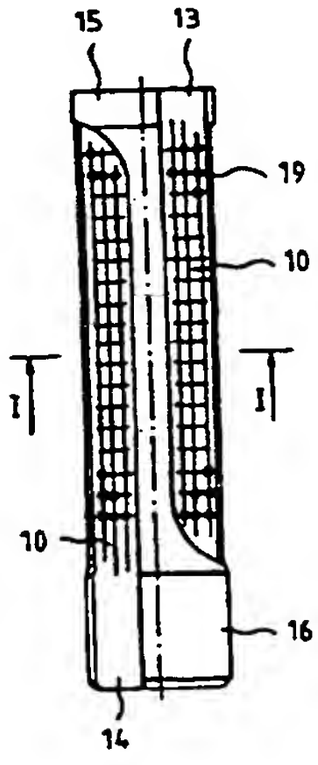

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Fig.1

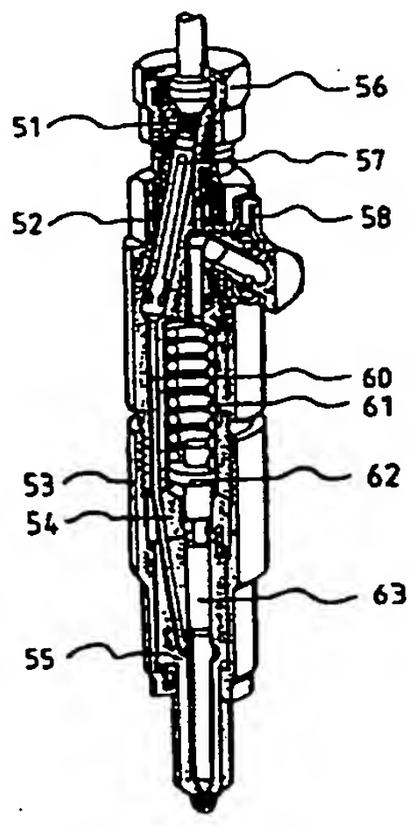

Fig. 5

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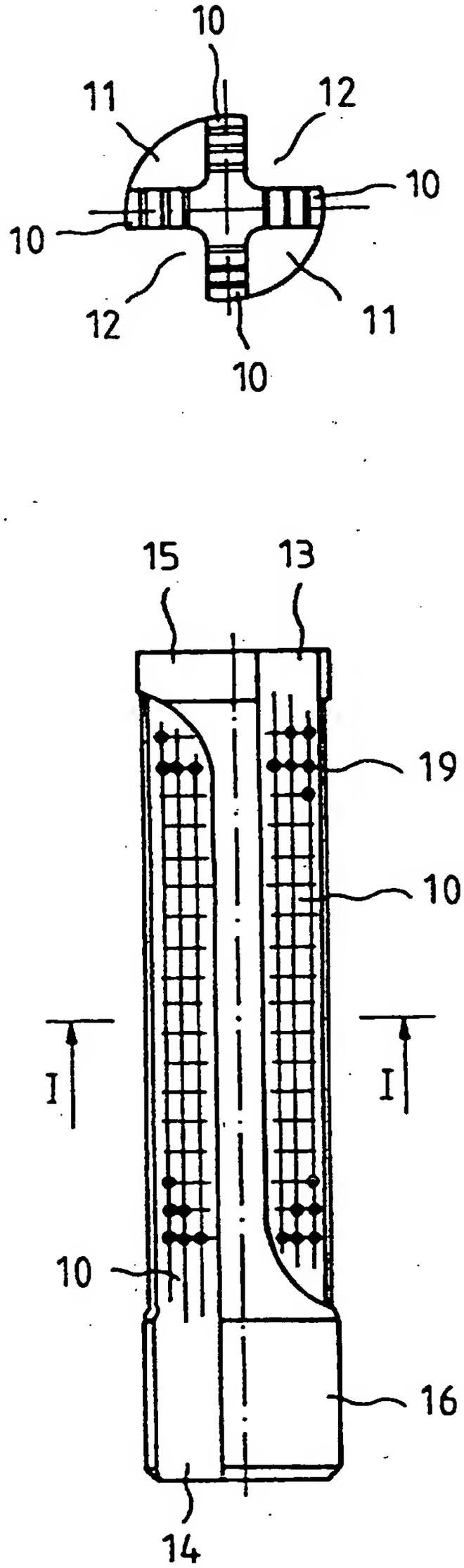
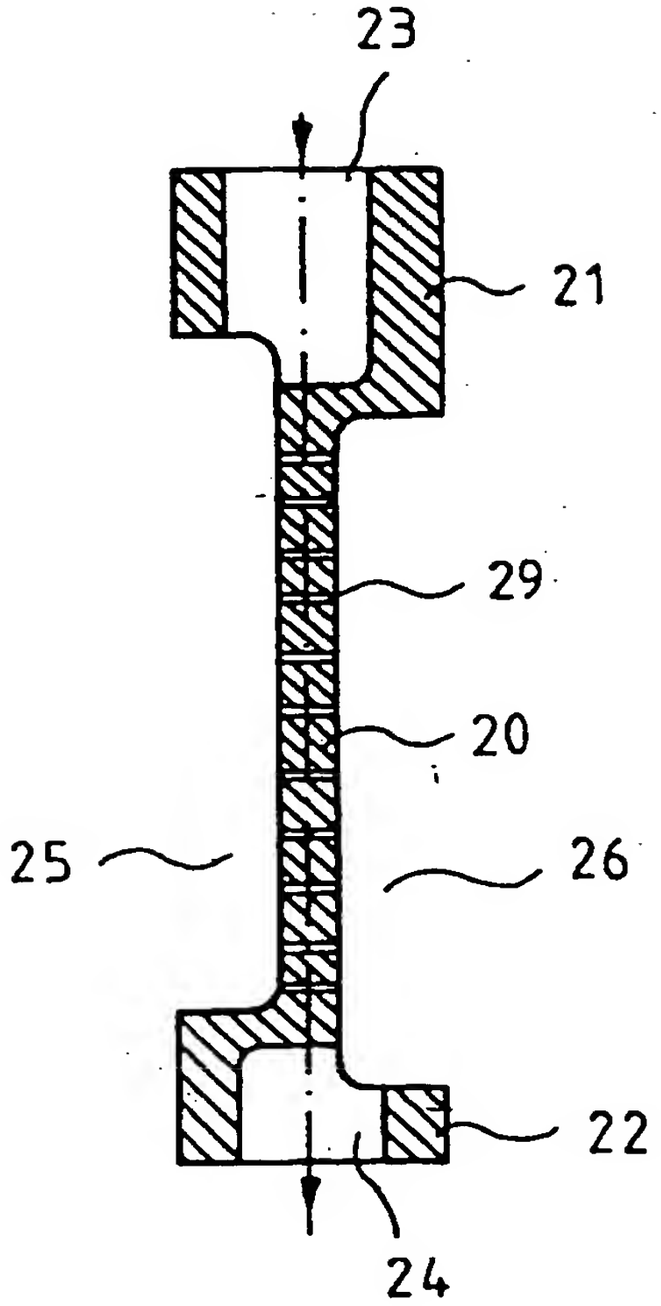
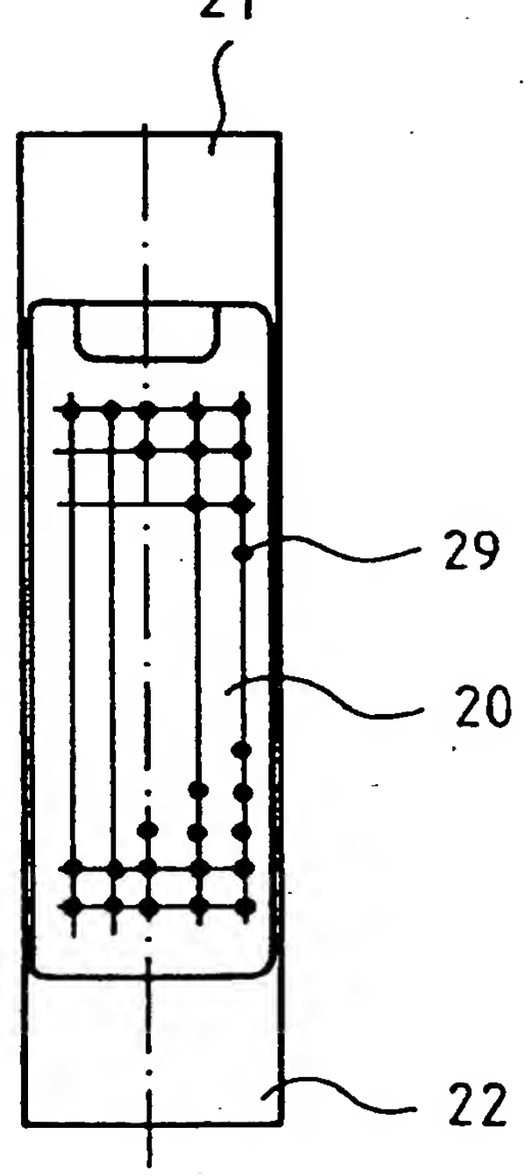
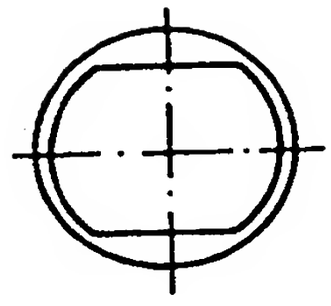


Fig. 1





a) Fig. 2 b)



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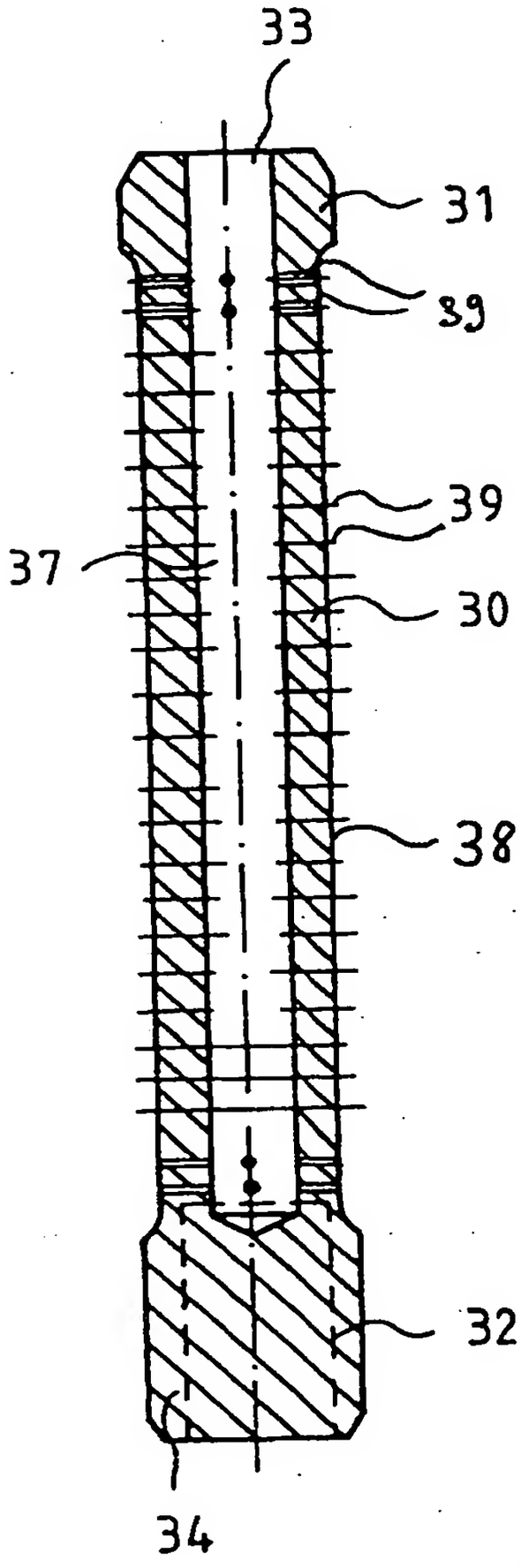
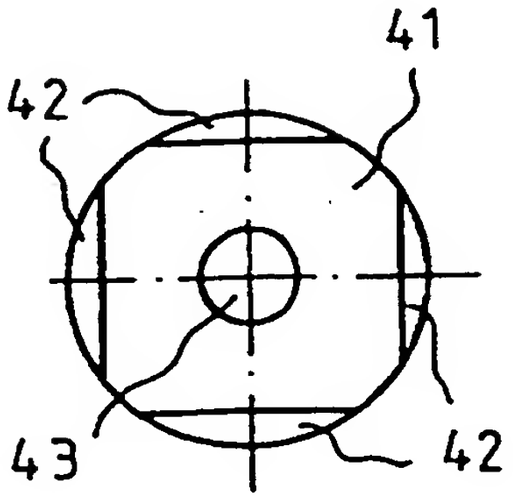


b)

Fig. 3



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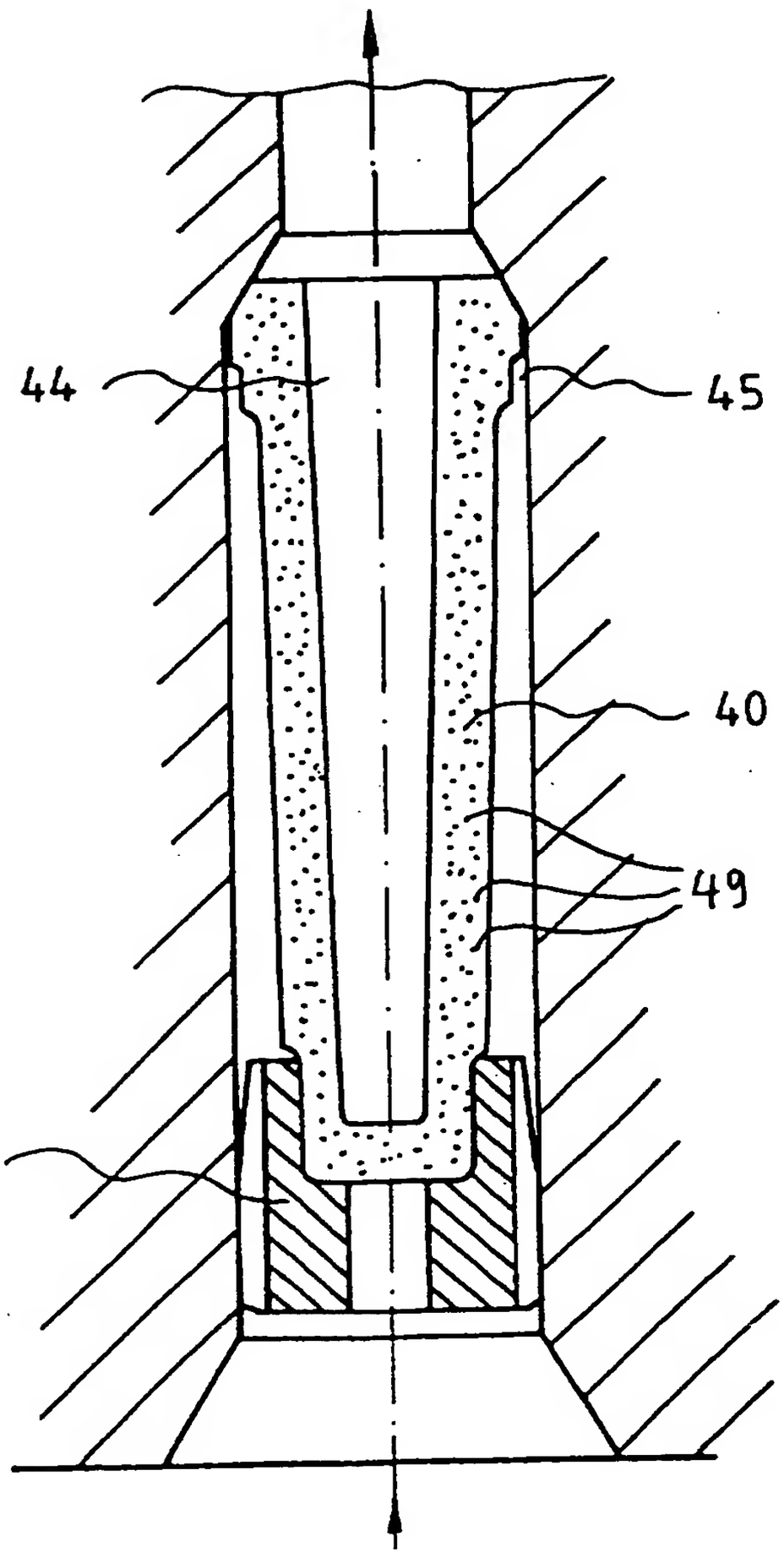

b)

Fig. 4

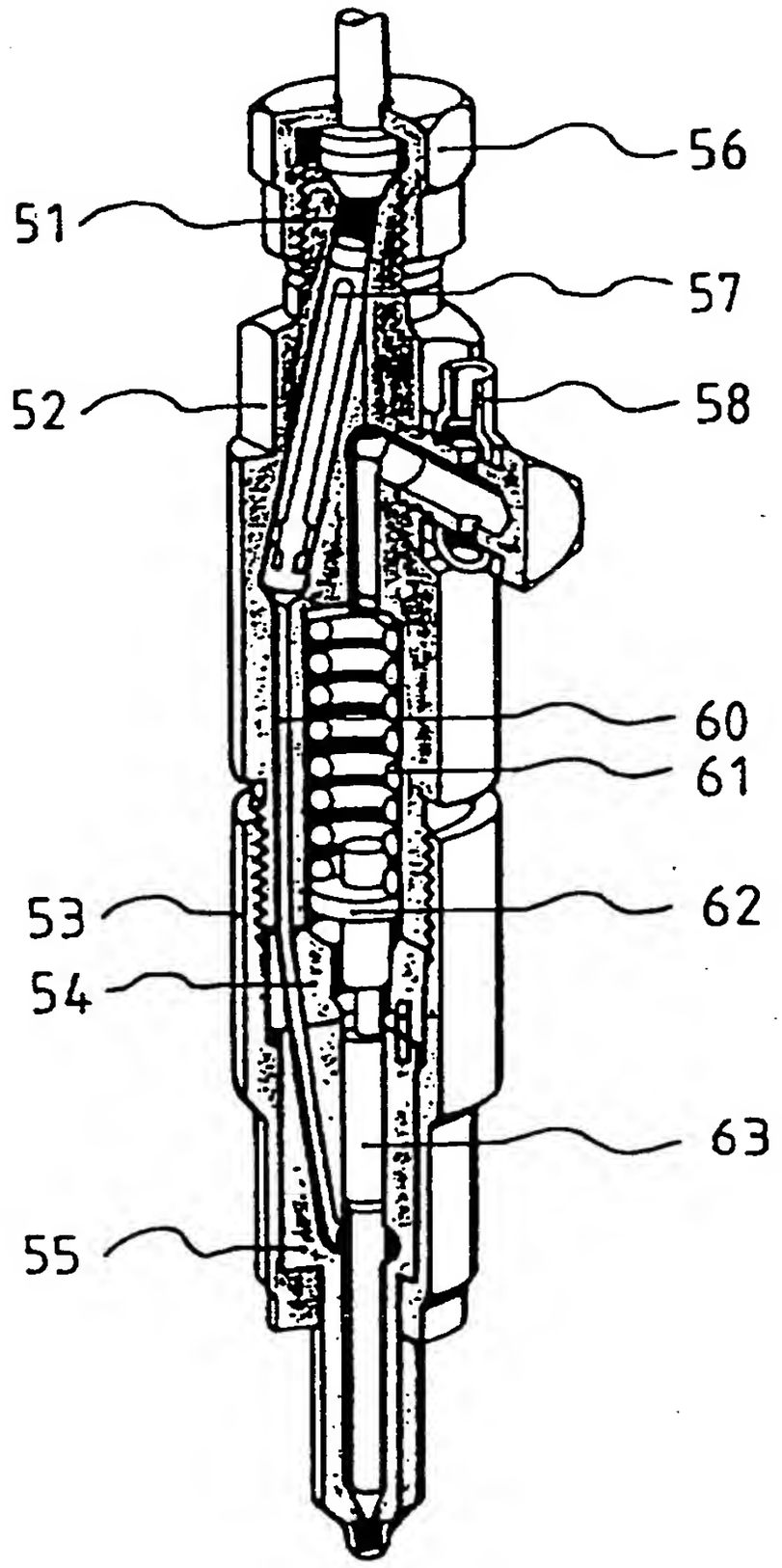

Fig. 5

DESCRIPTION

FUEL-INJECTION VALVE FOR INTERNAL COMBUSTION ENGINES

The invention relates to a fuel-injection valve for internal combustion engines having a rod-shaped filter body, which is disposed in a fuel duct mounted upstream of the injection orifice, comprises on its end face ends in each case a collar, which fills the duct cross-section in an appropriate manner, and comprises therebetween a middle portion which is connected to the fuel duct by way of orifices which are disposed in the collars.

A fuel-injection valve of this type is disclosed, for example, in EP 0 084 182. In the case of this fuel-injection valve the middle portion has a diameter which is smaller than the diameter of the collars. On the peripheral surface of said fuel-injection valve there are disposed two groups of longitudinal grooves, of which the one group issues from the one end face and the other group issues from the other end face. All of the grooves terminate in the middle portion.

Furthermore, DE 196 08 608.6 discloses an injection valve for internal combustion engines having a rod-shaped filter body which likewise comprises on its end face ends in each case a collar which is larger in diameter than a middle portion of the filter body, and into the peripheral surface of the said filter body are worked two groups of longitudinal grooves, which are closed axially on one side and of which a first group issues from an upper end face of the filter body remote

from the injection orifice, and a second group issues from a lower end face of the filter body facing the injection orifice and wherein the longitudinal grooves of the first and the second group are distributed in an alternate manner over the periphery of the filter body. In the case of this rod-shaped filter body the lower collar extends beyond the axially closed end of the longitudinal grooves of the first group for the purpose of forming receiving pockets for dirt particles. This serves to prevent in reliable manner particles of dirt from passing through the filter body.

In the case of filter bodies of this type the fuel, which is to be filtered, is forced, as it passes through the filter, through narrow gaps which are formed between the profiled outer periphery of the filter body and the wall of the fuel duct surrounding it. As a result for the purpose of filtering the fuel any entrained particles of dirt, chippings or the like of a predetermined size are held back.

A problem of filters of this type is that needle or plate-shaped parts, for example chippings having lengths and diameters which are larger than the orifice cross-section of the jet orifices in the valve body, can pass through the gap. This is particularly a problem in the case of injection valves which comprise extremely small jet orifices in the valve body.

Therefore, it is the object of the invention to improve a fuel-injection valve of the generic type in such a manner that in the case of straightforward production the filter effect is improved and is in particular

independent of the shape of the parts which are to be filtered out.

In accordance with the present invention, there is provided a fuel-injection valve of the type described initially, in which said at least one filter element comprises a plurality of orifices which extend preferably in the radial direction and comprise an orifice cross-section which is smaller than that of each jet orifice in the valve body.

By virtue of the fact that the valve body comprises a plurality of orifices which preferably extend in the radial direction and comprise an orifice cross-section, which is smaller in than that of each jet orifice in the valve body, it is possible that all parts, which adversely affect the functional competence of the injection valve and are therefore to be filtered out, are filtered irrespective of the shape thereof. In particular, needle or plate-shaped parts, for example needle or plate-shaped chippings are filtered out through the orifices which extend preferably in the radial direction.

Furthermore, filter elements of this type can be produced in a particularly convenient manner as explained in detail hereinunder.

An advantageous embodiment provides that a plurality of filter elements are provided in the form of cross pieces which extend in an axial manner and are disposed in a star-shaped manner in the radial direction and between which are disposed two groups of axially extending grooves which are closed in an axially manner on one side and one group of which issues from the one end face of the filter body

and the other group of which issues from the other end face of the filter body.

By virtue of the star-shaped arrangement of the cross piece-shaped filter elements it is possible to achieve in particular a uniform filter effect over a large surface.

In an advantageous manner it can be provided that the radius of the cross-pieces corresponds to the radius of the collars. In this case the filter effect occurs exclusively by virtue of the orifices disposed in the cross-pieces.

Furthermore, it can also be provided in the case of an advantageous exemplified embodiment that the radius of the cross-pieces is smaller than the radius of the collars, so that a gap is formed between the cross-pieces and the cylindrical surface defining the fuel duct and, in addition to the orifices disposed in the cross-pieces, renders possible a further filter effect in a manner which is described above and is known per se.

In the case of another advantageous embodiment it is provided that the filter element is a rectangular disc which is disposed centrally between the collars and is connected thereto and which, by way of orifices which are disposed axially in the collars and issue in an alternate manner on each one of the two sides of the disc, can be influenced by means of fuel which is to be filtered.

A filter element of this type and therefore the entire filter body can

be produced in a particularly convenient manner.

In the case of a further exemplified embodiment, which can also be produced in a convenient manner, it is provided that the filter element is a cylindrical body having a smaller diameter than the diameter of the collars and whose inner part is connected to the fuel duct by way of an orifice disposed in the first collar, and whose outer part is connected to the fuel duct by means of orifices disposed in the other collar. More specifically a filter element of this type renders possible extremely uniform through-flow characteristics, since the orifices are distributed over the entire periphery of the cylindrical body.

Details have hitherto not yet been provided with respect to the orifices themselves. In principle, it is possible for the orifices to be produced in a random manner.

However, the orifices are advantageously bores which can be produced extremely rapidly, and at the same time in an extremely precise manner also, for example by virtue of laser-boring.

In the case of a further, extremely advantageous embodiment it is provided that the filter element is a cylindrical or truncated, porous ceramic body. A porous ceramic body of this type is particularly advantageous with respect to the extremely convenient manner in which it is produced, since it is not necessary to provide subsequently orifices in the ceramic body.

In order to set the slightest possible flow resistance against the

fuel which is to be filtered, it is provided in an advantageous manner that the entire orifice cross-section of all of the orifices, which are preferably through-going in the radial direction, is larger than or equal to the cross-section of the fuel duct.

The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1a shows a plan view,

Figure 1b shows a lateral view of a filter body, which is used in a fuel-injection valve in accordance with the invention;

Figure 2a shows an axially sectioned lateral view,

Figure 2b shows a lateral view of a different embodiment of a filter body which is used in a fuel-injection valve in accordance with the invention;

Figure 3a shows a plan view,

Figure 3b shows an axially sectioned lateral view again of a different embodiment of a filter body which is used in a fuel-injection valve in accordance with the invention;

Figure 4a shows a plan view,

Figure 4b shows an axially sectioned view of a further embodiment of a filter body which is used in a fuel-injection valve in accordance with the invention; and

Figure 5 shows a sectional illustration of a fuel-injection valve which is known from prior art.

Description of the exemplified embodiments

An injection valve, which is known from prior art and illustrated in Figure 5, comprises a fuel duct 51 which is disposed in a holding body 52 and which is connected to a pressure chamber of an injection nozzle 55. The injection nozzle 55 is connected to the holding body 52 by way of a nozzle tensioning nut 53. A valve needle 63 can be moved in an axial manner by way of a compression spring 61 and comprises on it lower end a cone which cooperates with a conical seat, whereby a valve jet orifice 64 is opened and closed.

The hollow chamber, in which the compression spring 61 is disposed, is connected to a connection piece 58. This connection piece 58 serves to discharge any leakage oil which has passed into the spring chamber. A rod-shaped filter body 52 is disposed in the fuel duct 51 and comprises on its end face ends in each case a collar, which fills the

duct cross-section in an appropriate manner, and comprises therebetween at least one filter element. The filter element is connected to the fuel duct 51 by way of orifices which are disposed in the collars.

One exemplified embodiment of a filter body, illustrated in Figure 1a, 1b, comprises filter elements in the form of axially extending cross pieces 10 which are disposed in a star-shaped manner in the radial direction and between which are disposed two groups of grooves 11, 12 which extend in an axial manner and are closed in an axial manner on one side and whose one group 11 issues from the one end face 13 of a first collar 15 and whose other group issues from the other end face 14 of the second collar 16. In the cross pieces 11 there is disposed a plurality of uniformly distributed bores which have a diameter of approximately 0.1 mm and which can be produced for example by virtue of laser-boring and of which only some are illustrated in Figure 1 by way of example.

As is evident in Figure 1, the radius of the cross pieces 10 is smaller than the radius of the collars 15, 16, so that an annular gap is formed between the cross pieces 10 and the cylindrical surface defining the fuel duct and said gap produces an additional filter effect in a manner known per se and described in detail above. It should be noted that it is not necessary for this gap to be formed. On the contrary, the cross pieces 10 can also comprise the same radius as the collars 15, 16 and thus be inserted into the cylindrical duct in an appropriate manner.

In this case the filter effect is produced solely by the bores 19 which are disposed in the cross pieces 10. The bores 19 which extend in the radial direction ensure that no rod-shaped or disc-shaped particles can leave the filter body and thereby adversely affect the mode of function of the fuel-injection valve.

In the case of a second exemplified embodiment, illustrated in Figure 2, the filter element is a rectangular disc 20 which is disposed between the collars 21, 22 and connected thereto and which disc, by way of orifices 23, 24 which are disposed in the collars in an axial manner and issue in an alternate manner on each one of the two sides, can be influenced by means of the fuel which is filtered / to be filtered. A plurality of uniformly disposed and radially extending bores 29 is provided in the rectangular disc 20, thus preventing any rod-shaped or disc-shaped particles, which are larger than the orifice cross-section of each of the bores, passing through from the one side 25, which is connected to the fuel supply by way of the orifice 23, to the other side 26 of the filter element which is connected to the run-off of the fuel duct by way of the orifice 24.

In the case of a further exemplified embodiment, illustrated in Figures 3a, 3b, the filter element is a cylindrical body 30 which extends between two collars 31, 32 and has a smaller diameter than the diameter of the collars 31, 32. The inner part of the cylindrical body 30 is connected to the fuel duct by way of an orifice 33 which is disposed in

the one collar 31, whereas the outer part thereof is connected to the fuel duct by way of an orifice 34 which is annularly circumferential in the other collar 32. The orifice 34 represents the fuel inlet, whereas the orifice 33 forms the fuel run-off. In the periphery of the cylindrical body 30 there is disposed a plurality of radially extending bores 39 which serve to filter the particles which are to be filtered out. The fuel flows through the filter body in a radial manner, wherein the particles which are to be filtered out remain in the intermediate space between the outer diameter 38 and a bore, in which the filter element is disposed, and thus cannot pass to the fuel outlet.

In the case of all of the exemplified embodiments, which are illustrated above in conjunction with Figures 1 to 3, the individual bores comprise an orifice cross-section which is smaller than that of the jet orifices in the injection nozzle.

In the case of a further exemplified embodiment illustrated in Figures 4a, 4b, the filter element is a cylindrical or truncated porous ceramic body 40 which extends between two collars and whose one side is disposed in the fuel duct by way of a collar which is formed as a stopper 41. The stopper 41 essentially comprises four planar peripheral surfaces 42 and a central orifice 43 which form the inlet of the fuel. The stopper 41 is pressed into the fuel duct. The outlet is connected to a central chamber 44 which is disposed in the ceramic body 40.

The ceramic body 40 which is provided with pores is produced for

example by virtue of the fact that synthetic material parts having a dimension, which is smaller than the orifice cross-section of the jet orifice of the injection nozzle, are added to the initial ceramic mass. These synthetic material parts are later burnt out when the ceramic is fired, so that a plurality of small orifices 49 remains in the ceramic body, whose orifice cross-section is smaller than that of each jet orifice in the valve body.

As is further evident in Figure 4, the filter element comprises on its side facing the fuel run-off collecting pockets 45 for particles, e.g. chippings, which occur during the filter procedure. These chippings are broken up in an manner which is known per se by virtue of pressure pulsation.

In the case of all of the illustrated exemplified embodiments the entire orifice cross-section of all orifices disposed in the filter element is larger than or equal to the cross-section of the fuel duct.

CLAIMS

1. A fuel-injection valve for internal combustion engines comprising a rod-shaped filter body, which is adapted to be disposed in a fuel duct mounted upstream of the injection orifice and comprises on its end face ends in each case a collar, which fills the duct cross-section in an appropriate manner, and comprises therebetween at least one filter element, which is connected to the fuel duct by way of orifices which are disposed in the collars, said at least one filter element comprising a plurality of orifices which have an orifice cross-section which is smaller than that of each jet orifice in the injection nozzle.

2. A fuel-injection valve as claimed in claim 1, wherein said plurality of orifices extend substantially in a radial direction.

3. A fuel-injection valve according to claim 2, wherein a plurality of filter elements are provided in the form of axially extending cross-pieces which are disposed in a star-shaped manner in the radial direction and between which are disposed two groups of grooves which extend in an axial manner and which are closed in an axial manner on one side and one group of which issues from the one end face of the filter body and the other group of which issues from the other end face of the filter body.

4. A fuel-injection valve according to claim 3, wherein the radius of the cross-pieces corresponds to the radius of the collars.

5. A fuel-injection valve according to claim 3, wherein the radius

of the cross-pieces is smaller than the radius of the collars, so that a gap is formed between the cross-pieces and the cylindrical surface which defines the fuel duct.

6. A fuel-injection valve according to claim 2, wherein the filter element is a rectangular disc which is disposed centrally between the collars and connected thereto and which disc, by way of orifices which are disposed in an axial manner in the collars and issue in an alternate manner on each one of the two sides of the disc, can be influenced by means of the fuel.

7. A fuel-injection valve according to claim 2, wherein the filter element is a cylindrical body which has a smaller diameter than the diameter of the collars and whose inner part is connected to the fuel duct by way of an orifice, which is disposed in the one collar, and whose outer part is connected to the fuel duct by way an orifice which is formed in the other collar.

8. A fuel-injection valve according to any of claims 1 to 7, wherein the orifices are bores.

9. A fuel-injection valve according to claim 1 or 2, wherein the filter element is a cylindrical or truncated porous ceramic body.

10. A fuel-injection valve according to any of the preceding claims, wherein the entire orifice cross-section of all of the orifices, which are preferably through-going in the radial direction, is larger than or equal to the cross-section of the fuel duct.

11. A fuel-injection valve substantially as hereinbefore described with reference to and as illustrated in Figs. 1 to 4 of the accompanying drawings.

The Patent Office

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Application No: GB 9806897.6
Claims searched: 1-11

Examiner: David Glover
Date of search: 18 June 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): F1B (B2JCD); B1D (DNJA, DNRE)

Int Cl (Ed.6): F02M 61/16; B01D 25/22, 25/24, 25/26, 29/09

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2225383 A (Weber)	
A	EP 0084182 A1 (Robert Bosch)	
A	WO 97/33085 (Robert Bosch)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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